**1)** The acceleration, $a\ ms^{-2}$, of a particle at time $t$ seconds is given by $a = 2t + \cos t$.

A) Find the acceleration of the particle at $t = 0$.

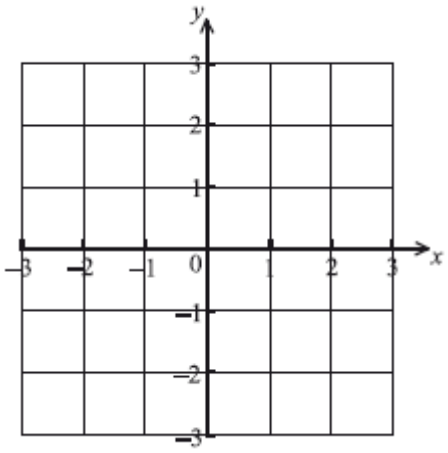
B) Find the velocity, $v$, at time $t$, given that the initial velocity of the particle is $2\ ms^{-1}$.

C) Find $\int_0^3 v dt$, giving your answer in the form $p - q\cos 3$.

D) What information does the answer to part C) give about the motion of the particle?

**2)** Let $f(x) = x\cos(x - \sin x),\ 0 \le x \le 3$.

A) Sketch the graph of $f$ on the following set of axes.




B) The graph of $f$ intersects the $x$-axis when $x = a,\ a \neq 0$. Write down the value of $a$.

C) The graph of $f$ is revolved $360°$ about the $x$-axis from $x = 0$ to $x = a$.

Find the volume of the solid formed.

**3)** Let $f(x) = e^{2x}\cos x,\ -1 \le x \le 2$.

A) Show that $f'(x) = e^{2x}(2\cos x - \sin x)$

Let the line $L$ be the normal to the curve of $f$ at $x = 0$.

B) Find the equation of $L$.

The graph of $f$ and the line $L$ intersect at the point $(0,1)$ and at a second point $P$.

C)

**I.** Find the $x$-coordinate of $P$.

**II.** Find the area of the region **enclosed** by the graph of $f$ and the line $L$.

**4)**

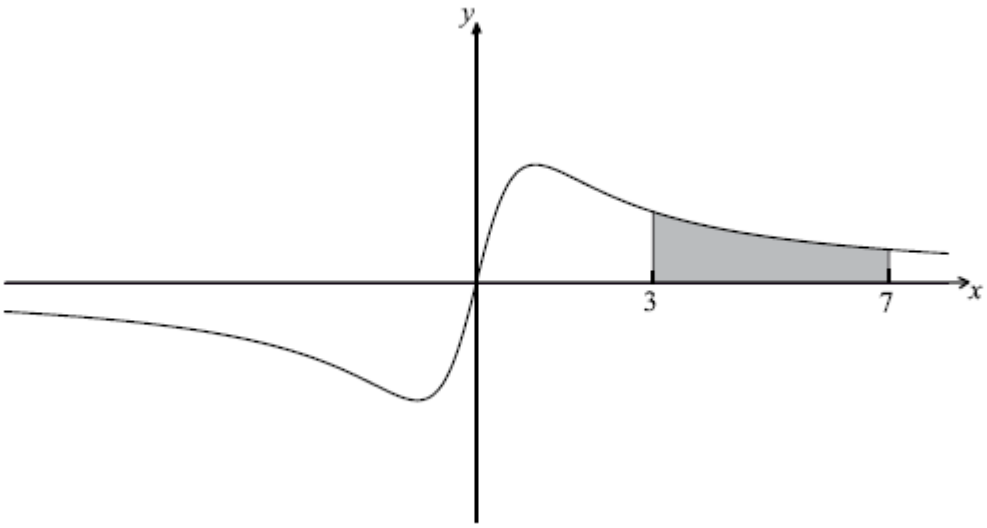
A) Find $\int \frac{1}{2x+3} dx$.

B) Given that $\int_0^3 \frac{1}{2x+3}dx = \ln\sqrt{P}$, find the value of $P$.

**5)** A particle moves along a straight line so that its velocity, $v\ m\ s^{-1}$ at time $t$ seconds is given by $v = 6e^{3t} + 4$. When $t = 0$, the displacement, $s$, of the particle is $7$ meters. Find an expression for $s$ in terms of $t$.

**6)** The graph of $y = \sqrt{x}$ between $x = 0$ and $x = a$ is rotated $360°$ about the $x$-axis.
The volume of the solid formed is $32\pi$. Find the value of $a$.

**7)** Let $f(x) = \frac{ax}{x^2+1}$, $-8 \le x \le a,\ a \in \mathbb{R}$. The graph of $f$ is shown below.




The region between $x = 3$ and $x = 7$ is shaded.

A) Show that $f(-x) = -f(x)$.

B) Given that $f''(x) = \frac{2ax(x^2-3)}{(x^2+1)^3}$, find the coordinates of all points of inflexion.

C) It is given that $\int f(x)dx = \frac{a}{2}\ln(x^2+1) + C$.

**I.** Find the area of the shaded region, giving your answer in the form $p\ln q$.

**II.** Find the value of $\int_4^8 2f(x-1)dx$.